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THE EFFECTS OF VARIOUS QUALITY POLARIZED LENSES ON COLOR VISION, STEREOPSIS, VISUAL ACUITY, AND CONTRAST SENSITIVITY

By

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The Authors of this paper feel fortunate to have had the opportunity to conduct a thesis study of great personal interest. Polarized lenses are commonly used by fishermen to reduce water surface glare and to locate fish. This "visual enhancement" is regarded as an aid to catching more fish. Fishing is an integral part of each of the authors lives, and the visual performance effects of these lenses may therefore have a direct bearing on how many fish wind up in the net.

The authors would like to express their appreciation to those who helped make this study possible. A majority of the credit belongs to Dr. Scott Cooper who, as the thesis advisor, provided the guidance necessary to complete the project. Thanks must also be given to those manufacturers who donated glasses to be evaluated in the study.

This thesis is dedicated to those Optometry students who have found fishing to be a priceless therapeutic to their sanity during their studies at Pacific. One can learn a great deal by taking the time to study a river, perhaps more than those who choose to drown themselves with school.

ABSTRACT

Polarized sunglasses are commonly used for glare reduction in tasks such as driving and in outdoor recreation such as fishing. These glasses are produced by many manufacturers and offered at a widely variable expense to the consumer. Studies of visual performance changes from plain tinted sunglasses including visual acuity, contrast sensitivity, stereopsis, and color discrimination have been completed in the past,[1,2,3,4] but these factors have not been studied with tinted polarized lenses. In this study, three groups of polarized sunglasses were assembled based on relative retail prices. The results of this study indicate that tinted polarized lenses affect the same changes that plain tinted lenses do, and the least expensive lenses were found to perform as well or better than the more expensive lenses in these four visual performance categories.

INTRODUCTION

Light has essentially three characteristics: brightness, color, and polarization.[5] The human eye interprets its surroundings using the first two properties, to which it is extremely sensitive. Humans are nearly insensitive to the third characteristic, polarization, unless polarized and non-polarized light are shown in succession.

Natural light is composed of waves that oscillate in a random pattern perpendicular to the direction of the wave's propagation. Light polarization occurs when a ray's wave front oscillates in a constant orientation. The most common polarization state found in nature is linearly polarized light.[5] When sunlight falls on water, much of it is reflected. The reflected light oscillates in a pattern normal to the plane of incidence and effectively becomes linearly polarized.[5] The formation of polarized light by reflection of a water surface is illustrated in Figure 1.

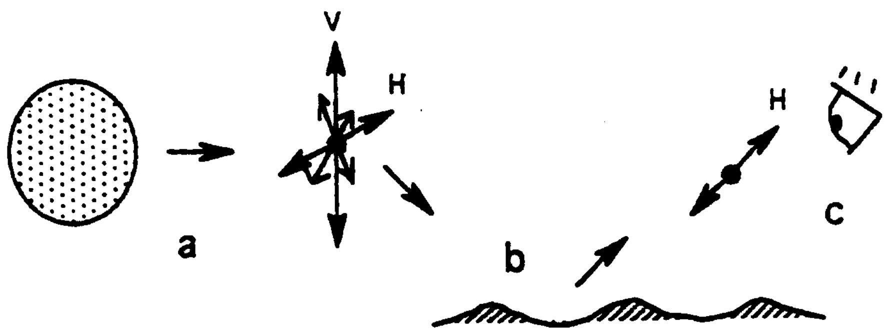

Fig. 1

Light from the sun is composed of randomly vibrating waves which include both vertical and horizontal components (a). When reflected from a water surface (b), it becomes horizontally polarized (c).

The amount of light reflected depends on the angle of the sun relative to the water surface.[5] This phenomenon was first described by Malus and later expanded upon by Brewster. Brewster's Law states that some of the incident light is refracted into the water while the rest is reflected. The angle of the polarized light in the reflected ray is perpendicular to the polarization angle in the refracted ray.[6] Depending on a given light's polarization, filters may have no effect upon how we view a certain object; allowing all polarized light to pass through. Or they may have a great impression upon how we view that object; blocking the vast majority of the polarized light.

Polarization due to reflection from water surfaces depends on illumination and the presence or absence of waves. Natural light reflected from the surface of a calm body of water is almost completely polarized in a horizontal orientation.[5] This reflected light is what humans perceive as "glare." Only the reflection of the most strongly polarized parts of the sky may have a slightly altered direction of polarization.[5] The majority of these polarized reflections, therefore, can be extinguished using polaroid filters which are horizontally aligned. With this glare effectively filtered, the water becomes more transparent and underwater objects become more discernible. As the reflective surface becomes less consistent, so

does the reflected light's polarized component. The addition of waves to the water surface, for example, would cause this component to contain additional orientations of polarized light. These additional orientations of light will not be completely filtered by the polarized filter and will therefore result in increased glare.

The development of the polarizing filter has been a significant achievement in the modern eyeglass industry. Since Edwin H. Land produced the first synthetic polarizer in 1926, polarized lenses have enjoyed widespread use to decrease glare.[7] This, of course, has resulted in a large market, numerous manufacturers and a wide range of product quality and expense. Many manufacturers make claims about the visual benefits of their products, such as increasing contrast or sharpness of detail with the use of their lenses. The disparity in expense amongst polarized sunglasses leads to the question of whether true visual performance differences actually exist due to optical quality (for consumers, "quality" would likely be identified by the retail price of the lenses) or if these benefits are universal due to the polarizing characteristics.

Perceptual differences can be tested for in a variety of areas such as visual acuity, depth perception, contrast sensitivity, and color discrimination. While relatively few studies have incorporated tinted polarized lenses, many studies have been conducted on the performance of regular tinted sunglasses in these four areas.

A study by Miller found visual acuity to be dependent upon illumination levels.[1] Vision with sunglasses was not decreased in light levels ranging from 300 to 3,000 candelas/meter^2. This represents a range from common indoor lighting to moderate daylight conditions. As illumination levels increase from this range, however, studies have shown visual acuity begins to decrease. Similarly, as illumination decreases below a certain level, visual acuity again begins to decrease.[1] This implies that polarized lenses may have an effect on visual acuity in low light conditions due to decreased illumination levels associated with polaroid filters and tints.

Unlike visual acuity, decreased illumination levels have been shown to have a negligible effect on stereoacuity. Testing performed

through polarizing lenses with neutral density filters revealed decreased retinal illumination had an insignificant effect on stereopsis with the Randot 3 Circle Stereotest.[3] One might expect that the decreased illumination levels induced by polarized lenses would therefore have no effect on stereoacuity. It has not been reported in the literature whether the polarizing characteristics of the lenses may potentially cause significant perceptual differences in stereoacuity.

Contrast sensitivity has been found to be significantly improved with the use of yellow filters.[2] Black on yellow has long been known to give the best visual contrast, therefore most directive and cautionary road signs are painted black on yellow. Certain polarized lens manufacturers have made product claims contending that their products actually increase contrast sensitivity without citing research to support their claims. It is unknown whether the same results obtained with yellow filtered lenses can be repeated using tinted polarized lenses.

Filters have also been determined to have varying effects upon color discrimination. Neutral grey filters produce minimal color defects whereas yellow colored filters have a more marked distortion of color perception.[4] The majority of polarized lenses available today are tinted. It is logical to assume that tinted polarized filters should perform similarly to regularly tinted lenses. Differences in color perception may exist, however, between lenses of different price ranges.

In reviewing the literature, the authors noted that there have been many studies concerning the visual effects of plain tinted lenses and relatively little published about the effects of tinted polarized lenses. The authors realized a need for determining the visual performance effects of these lenses. Furthermore, the authors wanted to determine whether differences truly existed between less expensive and more expensive pairs of polarized sunglasses.

MATERIALS AND METHODS

A total of nine pairs of polarized sunglasses were obtained for testing purposes. The glasses were either purchased by the examiners or donated by various manufacturers. The glasses were categorized according to suggested retail price. Three categories were arbitrarily chosen as follows: 1) less than $15, 2) $16-99, and 3) $100 and above. Each of the three categories contained three pairs of glasses. All identifying marks on the glasses were masked so that, other than style, there were no clues to relative retail value.

The glasses chosen to be evaluated in this study are as follows:

	Manufacturer/Name	Suggested Retail Price
Group 1	Foster Grant Aquamates	$ 12.99
	Fisherman's Eyewear	15.00
	Emerald Sun Vision	14.99
Group 2	Bushnell Sportview	23.95
	Teeny Nymph Co. Teeny Locator	49.95
	Simmons Model #1362	23.95
Group 3	Revo H_2O	185.00
	Serengeti Strata	330.00
	Smith Cheetah	99.95

The authors would like to emphasize that the lenses in this study were not tested for their optical quality or purity. The lenses, instead, were examined for changes effected in visual performance according to retail price since this is the primary basis for consumer perception of quality. Therefore a warped lens, or one of low optical quality in any price range, would be considered a viable candidate for this study.

All subjects were screened to make sure they met the criteria of the research experiment. In order to participate, all subjects were required to be either emmetropic or contact lens wearers. The use of corrective spectacles by subjects was not allowed in this study. Wearers of colored contact lenses were also excluded. Screening criteria included: 1) Snellen distance and near visual acuities of 20/20 OD, OS, and OU; 2) a normal passing error score of 80 or below on the Farnsworth-Munsell 100 Hue Test; and 3) stereopsis

of at least 80 arcseconds as determined by the Keystone Aviator Series. In addition to these tests, a baseline contrast sensitivity measurement was obtained using 20/20 sized Landolt C's with variable contrast on the Mentor B-VAT II-56. All screening tests were administered using standard testing conditions and procedures.

Upon passing of screening criteria, 30 subjects were randomly assigned to one of the three categories (10 each). The three randomly assigned groups were tested with one of the three categories of glasses. All subjects in each category were tested with the three pairs of glasses assigned to that specific category in random order. Three test administrators were used throughout the duration of the study. Each administrator provided the same instruction set and administrative procedures.

The B-VAT 11-56 was utilized to test for any changes in visual acuity and contrast sensitivity using standard protocols set forth in the B-VAT II instruction manual. Standard room illumination was utilized.

Visual acuity testing was performed using standard Snellen letters on the B-VAT 11-56. Random letters were used to insure that no chart memorization was possible.

Contrast sensitivity was performed on the B-VAT 11-56 using constant 20/20 sized Landolt C's while varying the percentage of contrast. Contrast was decreased until the subject could no longer determine direction of Landolt C's which were randomized with each change of contrast. Standard room illumination was utilized.

Stereopsis was measured with the Aviator Series cards in a Keystone Telebinocular Stereoscope using standard procedures. This allows for stereopsis testing to 10 arcseconds at infinity.

The Farnsworth-Munsell 100 Hue Test was employed to measure any changes in color perception. In accordance with the administration guidelines, illuminant C (6500^0K) was used as the illumination source. The angle of illumination was 45 degrees, while the angle of viewing was 90 degrees. Instruction sets, time allotments, recording, and scoring procedures were all followed in strict accordance with the administration guidelines set forth in the instruction manual.

Each subject was advised that the testing procedures would consist of two phases so they would expect to make two visits. Part I testing determined whether differences existed between lenses in the same price category. If differences were not found, one pair of lenses would be chosen to represent each test category in part II. If differences did exist between lenses, these "different" lenses were also included in part II. Part II testing would examine the differences between the three groups (price ranges) of glasses with a larger effective subject pool.

Each subject was first tested without polarized lenses to obtain a baseline value for each test category. Next each subject was tested with the three pairs of glasses in their designated group on color vision, stereoacuity, contrast sensitivity, and visual acuity in random order.

Subjects in group 1 were tested only on the least expensive glasses while groups 2 and 3 were tested on the intermediate and the most expensive glasses respectively. The glasses in each group were randomly assigned numbers. Group 1 consisted of glasses numbered 1, 5, 7; group 2 consisted of glasses numbered 3, 4, 9; and group three consisted of glasses 2, 6 and 8. Lenses 6, 7 and 9 (one in each group) were tinted brown while the rest were grey.

Group	Assigned Numbers
1	1,5,7*
2	3,4*,9
3	2,6*,8

*brown tinted lenses

A statistical analysis was run on the gathered data from part 1 to look for significant differences between the baseline and lens values from a given price category. The Statview 512 statistical analysis program was used to compute the data. The significance level was set at $p<.05$. A paired two-tailed t-test was employed to check for differences between results of tests run with each pair of glasses vs. the control value. A one factor ANOVA test for repeated measures within subjects was then run to determine differences between the 3 pairs of glasses for each testing category.

An example of this testing sequence is as follows: Each subject in group 1 was tested without lenses to obtain a baseline value for their visual acuity. Next, each participant was tested on glasses 1, 5 and 7 for visual acuities. The results of these tests were entered into the Statview computer program. Three t-tests were run to determine if there were any significant differences between acuities without lenses vs. acuities with each of the pairs of glasses. Finally, an ANOVA test was run to check for any differences between acuities obtained from the three pairs of polarized lenses in group 1.

In part II of the experiment, all subjects were asked to return for further testing. Returning participants were tested on the two remaining groups of glasses they had not previously been assigned to in part I. This data was gathered for an analysis of variance between the three groups of polarized lenses.

To simplify both the testing and analysis procedures, not all lenses were tested in part II. If all lenses of a group in part I provided statistically identical results for a given test (i.e. contrast sensitivity) then only one representative pair for this price category was used for testing in part II. In addition, if any of the glasses showed significant differences in part I, these glasses were also included in part II. This allowed for 30 subjects' results per visual component for each price range of glasses.

Testing conditions and procedures were identical to part one of the experiment. The gathered data was again entered into the Statview 512 program. Average test values for the subjects were determined and paired t-tests were run to check for differences from the control value. An ANOVA test was run on each testing category to look for differences between lenses selected from the three groups.

RESULTS

Part I: Comparison of Baseline and Lens Values Within Each Group

The results of part 1 of the experiment are as follows:

Group 1	Color Vision (Color Error Score)	Stereo Acuity (Arc Sec)	Contrast Sensitivity (Cycles/Degree)	Visual Acuity (Arc Min)
Ave. Control Values	26.6	48.3	22.0	4.00
Pair 1	29.0	62.8	36.2**	4.50**
5	35.5	58.6	34.0**	4.00
7*	41.6**	65.6	35.5**	4.25
Anova Results	1≠7	NSD	NSD	1≠5

Group 2	Color Vision	Stereo Acuity	Contrast Sensitivity	Visual Acuity
Ave. Control Values	41.4	49.7	17.3	3.88
Pair 3	40.0	44.6	36.8**	4.25
4*	36.4	50.5	33.2**	4.00
9	45.8	50.2	28.2**	4.00
Anova Results	NSD	NSD	3≠9	NSD

Group 3	Color Vision	Stereo Acuity	Contrast Sensitivity	Visual Acuity
Ave. Control Values	36.2	44.4	21.9	3.88
Pair 2	54.2	50.5	37.4**	4.50**
6*	43.8	54.0	37.2**	4.25
8	85.6**	45.3	38.4**	4.50**
Anova Results	2,6≠8	NSD	NSD	NSD

*Brown tinted lenses

**t-test values show significant differences from control value

NSD-No significant differences exist between lenses within group

Some general trends were revealed during the analysis of the results from group 1. Beginning with color vision, no significant differences from the baseline value were discovered. The ANOVA results, however, indicated glasses 1 and 7 to be significantly different from one another. Both glasses 1 and 7 were selected as

representative pairs for part II in the color vision testing. The stereoacuity analysis also failed to show any significant changes in performance with the three pairs of lenses compared to the baseline score. The ANOVA results showed that all glasses were approximately the same within the group. Pair 1 was chosen to be the representative pair for the stereoacuity testing in part II. The contrast sensitivity scores proved to be significantly lowered by all glasses in group 1. The ANOVA results showed that these glasses were also statistical equivalents. Pair 1 was chosen from the group for further testing in part II.

The visual acuity test results showed little deviation from the baseline vs. polarized lens values. Although the computer program found significance in the analysis, the differences were clinically slight in all three groups. The visual acuity scores were converted to angular subtense equivalents. For calculation purposes, the conversions were based on the height of the smallest Snellen letters perceived. Analyses of both visual angle and percent efficiency equivalents showed little significance between baseline and lens values. Pair 5 of group 1 matched the baseline value while all other lenses slightly decreased visual acuities. Glasses 2 and 8 from group 3 affected visual acuity the most. Both increased the angular subtense values .62 arcseconds from the baseline value. This, however, represents an approximate decline in visual acuity from the 20/18 to 20/20 level. The relatively small decrease in acuities through all lenses is considered by the experimenters to be clinically insignificant and did not provide enough acuity range to merit checking acuity in part II. Visual acuities obtained through all polarized lenses tested in this study are therefore assumed to be approximately equal to one another similar to findings of previous studies.[1]

In the analysis of group 2, all color vision and stereoacuity scores were found to be statistically equal to their respective baseline values. The ANOVA results indicated that all lenses in group 2 performed equally in both categories as well. Pair 4 was selected to represent the group for part II in both color vision and stereoacuity testing. All contrast sensitivity scores were significantly lowered by

the glasses evaluated in group 2. The ANOVA results, however, showed pair 3 to decrease contrast sensitivity significantly more than pair 9. As a result, both pair 3 and 9 were chosen for further evaluation in part II.

In the analysis of group 3, only pair 8 was found to significantly alter color vision. Pair 8 varied greatly from the baseline score and subsequently the ANOVA results showed both pairs 2 and 6 significantly differing from pair 8. Both pairs 6 and 8 were selected to represent group 3 in color vision testing for part II. The stereoacuity scores for group 3 exhibited little significance. There were no deviations from the baseline value and the ANOVA results indicated the glasses were considered statistically equal. Pair 2 was chosen to be the representative pair for this group during stereoacuity testing in part II. Like the results obtained with group 1 and 2, all glasses in group 3 significantly decreased contrast sensitivity scores compared to the baseline value. The ANOVA results showed all glasses in group 3 to be approximately equal. Pair 2 was selected to represent group 3 for further contrast sensitivity testing in part II.

Part II: Comparison Between Groups

Twenty-nine of thirty subjects returned for the second testing session. No further testing on visual acuities was completed due to the lack of clinical significance exhibited in part one.

The lenses chosen per testing category were as follows:

	Group		
Testing Category	**1**	**2**	**3**
Color Vision	1,7	4	6,8
Stereoacuity	1	4	2
Contrast sensitivity	1	3,9	2
Visual Acuity	-	-	-

The results of part II of the study are as follows:

Color Vision					
Ave. Control Value 32.7					
Group 1		Group 2		Group 3	
Pair 1	28.5	Pair 4	34.4	Pair 6*	39.7**
7*	42.2**	-		8	75.2**
Anova Results: 1=4>6=7>8					

Stereoacuity					
Ave. Control Value 46.3					
Group 1		Group 2		Group 3	
Pair 1	47.8	Pair 4*	51.3	Pair 2	47.8
Anova Results: All Levels Approx. Equal					

Contrast Sensitivity					
Ave. Control Value 20.3					
Group 1		Group 2		Group 3	
Pair 1	30.4	Pair 3	35.6	Pair 2	34.8
-		9	31.0	-	
Anova Results: 1=9> 2=3					

*Brown tinted lenses

**t-test values show significant differences from control value

COLOR VISION

It should be noted that error scores on the Munsell Hundred Hue between 24 and 80 are considered normal. Superior scores are those that fall below 24 and low scores are considered those greater than 80.

The color vision data shows that only pair 1 of group 1 posted a lower color error score than the baseline value. This slight enhancement, however, was found to be statistically insignificant. All other tested glasses produced error scores greater than the control value. The data shows lens pairs 6, 7, and 8 significantly altered color vision error scores from the baseline value.

Comparing the groups to one another, error scores for group 1 (pair 1) and group 2 (pair 4) were found to be statistically equal and lower than the scores of the other lenses tested. The next lowest error scores were provided by group 1 (pair 7) and group 3

(pair 6) which were also determined to be statistically equal. Pair 8 of group 3 produced a color vision error score significantly higher than all other lenses tested.

STEREOACUITY

The stereoacuity scores basically duplicated the results found in part I. The ANOVA indicated the lenses yielded insignificantly different results.

CONTRAST SENSITIVITY

The trend seen in part I for the contrast sensitivity scores continued in phase 2. All lenses were found to significantly decrease contrast sensitivity from the control value. The data shows contrast sensitivity scores for group 1 (pair 1) and group 2 (pair 9) to be statistically equal and superior to.the other lenses tested. Although all lenses decreased contrast sensitivity scores from the baseline value, groups 2 (pair 3) and 3 (pair 2) decreased the scores the greatest. The statistics show these two pairs of lenses to be approximately equal.

CONCLUSION

The current large disparities among the cost of polarized lenses suggests that there should be quality and performance differences between the groups. Though this study did not pursue optical quality, polarizing efficiency, or material differences, a general trend showed that, with some visual component measures, the least expensive lenses performed as well as or better than the most expensive pairs.

For example pair 1 (group 1), a grey pair in the least expensive group, posted the lowest color vision error score while pair 8 (group 3), a grey pair in the most expensive group, had the highest error score by more than 30 points, indicating the most negative influence on the color spectrum. As expected, all lenses tested fell within the "normal" color vision range. However, statistically significant differences were shown to exist in this normal range between groups

of lenses. It should also be understood that color error scores are overall scores for the entire color spectrum. These results of this study do not offer a spectrally-specific breakdown of the subjects' scores.

Kuyk and Thomas reported that neutral density filters had no effect on color vision while selective chromatic filters produced an increase in color error scores.[4] Because of the relatively few number of lenses tested, this study failed to show that color vision performance levels of either grey or brown tinted lenses were superior to one another. Two of three brown lenses tested in part II produced significantly higher error scores than the baseline values. One of two grey lenses produced this same result. The experimenters noted that error scores of grey lenses, simulating neutral density filters, tended to occur in a random pattern across the visible spectrum. The brown tinted lenses, containing a yellow filter component, tended to increase error scores at the blue end of the spectrum. This suggests the claims of some companies that brown tinted polarized lenses are more useful for green to brownish water conditions are likely valid.

All lenses tested in phase two decreased stereoacuity by a slight margin. The average margin of reduction was 2.7 arc seconds per lens pair. The analysis showed that these differences were insignificant compared to the control value and that all lenses tested were considered statistically equivalent. The lenses tested in this study, therefore, are considered to have had no major effect on stereoacuity performance levels.

The least expensive glasses performed slightly better in contrast sensitivity testing. All lenses, however, were found to significantly decrease contrast sensitivity from 50-75%. This data seems to refute many of the manufactures claims that their products enhance or boost contrast sensitivity performance levels. This study showed conclusively that under normal room illumination, and without any glare conditions, polarized lenses significantly reduce contrast sensitivity.

An efficient polarized lens significantly reduces glare from reflective surfaces. When this glare is filtered out, the fisherman, for example, is able to see more clearly through the surface of the water. This glare reduction may improve contrast in this situation so that objects can be more clearly recognized under the surface of the water. But in reality, do polarized lenses improve contrast sensitivity in a given situation by decreasing glare or do the lenses actually possess properties to boost contrast sensitivity when glare is not present? The data from this study seems to indicate that the tested lenses decrease contrast sensitivity in non-glare conditions. From the results of this study, in situations when there is little to no glare, one would not want to wear polarized lenses because it would decrease contrast sensitivity and perhaps color vision as well. This could have a negative impact on visual performance. These situations could occur when it is very overcast, in the early morning, or late in the evening. The removal of lenses during this time period may dramatically improve the fisherman's ability to spot desired targets.

As stated before, visual acuities remained virtually the same as the control value through all lenses tested. It can be concluded that the lenses tested in this study had no clinically significant effects on visual acuity performance levels although a few sensitive individuals may be able to notice a slight decrease with poorer quality lenses.

Although the results show the least expensive lenses perform as well as or better than the most expensive lens pairs in these areas of visual performance, further studies are necessary in this area. Clark found that sheet polarizers commonly used in polarized sunglasses were inefficient absorbers of near infra-red radiation.[8] Spectral absorbance characteristics of various lenses should be evaluated for any potentially dangerous IR or UV transmittance. Perhaps differences exist in the absorption of near IR between glasses of varying cost.

The testing conditions in this study were regulated to standard room illumination without any glare conditions. Various illumination levels may affect the performance levels tested in this study. For

example, a future study could assess visual acuities performed through polarized lenses in a standard glare tester as used in cataract evaluations. In addition, study of how various quality polarized lenses effectively reduce glare may show differences between higher vs. lower valued glasses.

While the study showed some significant differences from the baseline values and between price brackets, increased cost was not an indicator of superior visual performance by the users. So although there may be better optical quality, UV filtering properties, lens coatings, frame qualities and durability between various manufactures, the consumer should not base their purchase on visual performance enhancement. The potential exception may be better perceived glare reduction which was not analyzed in this study.

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Bausch and Lomb Sports Optics
Corning Optics
Revo
Simmons Outdoor
Smith Sport Optics
Teeny Nymph Company

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Appendix of Manufacturers

Bausch and Lomb Sports Optics, 9200 Cody, Overland Park, KS, 66214.

Corning Optics, 1480 Colonial Dr., Horseheads, NY, 14845.

Emerald Sun Vision, distributed by PMA Marketing, 1500 NE 143rd Ave., Vancouver, WA, 98684.

Foster Grant, P.O. Box 819084, Dallas, TX, 75381.

Fisherman's Eyewear, P.O. Box 261, 1700 Shelton Dr., Hollister, CA, 95024-0261.

Revo, 455 East Middlefield Rd., Mountain View, CA, 94043.

Simmons Outdoor, 2571 Executive Ctr., Circle E., Ste. 100, Tallahassee, FL, 32301.

Smith Sport Optics, P.O. Box 2999, Ketchum, ID, 83340.

Teeny Nymph Company, P.O. Box 989, Gresham, OR, 97030.